



# California Hydropower System: Energy and Environment

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## Energy Commission Programs on Hydropower

- Electricity Analysis Office
  - Assessments on production, costs and systems level resource adequacy issues
- Special Projects & Environmental Offices
  - Environmental assessments
  - Energy and environment policy issues
- Public Interest Energy Research
  - Scientific research such as Pulse Flow Study



## CEC Investigations on Hydropower for 2003 IEPR

- California Hydropower System:  
Energy and Environment Report
  - Appendix D to 2003 Environmental Performance  
Report on California's Power Generation System
    - Prepared as part of California's first Integrated Energy Policy  
Report
    - Report No. 100-03-018, Oct 2003
  - Requested by Resources Secretary Mary Nichols
    - Look at energy and cost effects of relicensing and  
decommissioning



## Summary of Findings

- Hydroelectricity is Important Element of California's Energy Portfolio
- Hydropower Contributes to Significant, Ongoing Environmental Impacts
- FERC Relicensing and Other Restoration Efforts Provide Opportunities for Mitigation and Restoration
- Mitigation and Restoration of Rivers Can Be Achieved with Minimal Effect on Energy Values
- Relicensing and Selective Decommissioning Are Not Expected to Affect State-Wide Electricity System Reliability



# General Environmental Impacts from Hydropower

- Sierra Nevada aquatic ecosystems are among the most altered and degraded of all habitats, with dams cited as a major degradation factor (SNEP).
- Two thirds of California fresh water fishes directly impacted by hydro.
  - Thousands of miles of rivers and streams cannot support sustainable populations of native aquatic species (CPUC DEIR on PG&E Hydro Valuation).
- Two thirds of California's native fish are extinct, endangered or in decline.
  - Four species of salmonids, three of 11 native trout species and several amphibians now listed under Endangered Species Act (CPUC DEIR)
- 95% of original 6,000 miles of Central Valley salmonid habitat, and 90% of Sierra Nevada salmonid habitat lost to dam construction (NMFS)
- Only 9 of 119 FERC-licensed projects meet current State of California water quality standards, as certified by State Water Resources Control Board (CEC)



## CEC Review of Energy Effects of FERC Licensing

- No objective, documented study of energy effects from relicensing in California
- Potential energy losses issue of state and national concern
- **CEC & Aspen Reviewed 14 Recent Relicensing Cases in California**
  - Pre-Relicensing totals = 567 MW capacity, 2,804 GWh annual production
- Results
  - Net Average Annual Loss of 147 GWh
  - Total 5.26% decrease in average annual energy production
- Context
  - California average hydro production is 37,345 GWh, 15% of state load
  - Average summer daily load about 700 GWh



## Hydropower Economics and Relicensing Costs

- CEC commissioned initial investigation from energy economist Dr. Richard McCann
  - Reviewed 26 California projects – PG&E, SCE, SMUD, DWR
- Unlike other electricity generation sectors, no objective data on financial costs of repowering or modernizing hydro facilities to conform with current environmental standards



# Hydropower Costs and Revenues

- Revenues
  - Storage / Peaking Projects: \$40 to \$70 per MWh
  - Run of River Projects: \$30 to \$35 per MWh
- O&M Costs
  - >30 MW: \$2 to \$7 per MWh
  - <30 MW: \$10 to \$15 per MWh
- Net Margins
  - \$20 to \$75 per MWh for larger, peaking plants
  - About \$20 per MWh for smaller, run of river units
- Combined Cycle Gas Plant
  - Production costs average \$32 per MWh
  - Average wholesale price about \$51 per MWh





## Anadromous Fisheries Restoration and Energy Effects

- CEC reviewed the energy effects of proposals to decommission / reoperate 3 hydro projects to promote salmon fishery restoration
  - Battle Creek
  - Trinity River Division of CVP
  - Klamath Hydro Project
- Salmon restoration is California policy objective, but questions about significance of energy losses



## Summary of 3 Projects

Project	Capacity	Energy	Energy Losses		Expected Benefits
			MW	GWh	
Battle Creek	36.3	245	7.2	93.8	42 miles of cold-water habitat for Chinook and steelhead
Trinity River Diversion	497	NA	7	287	Restore flows to 48% of historic average, benefiting Chinook, coho and steelhead
Klamath	163	656	163	656	300 additional miles of mainstem and tributary habitat for Chinook and steelhead
Totals			172.2	1037	
% of State			1.2%	2.7%	



## Summary of Findings

- No adverse effect on electric resource adequacy
- Selective decommissioning to help restore anadromous fisheries is a viable policy and project option under CEQA and NEPA
- Low energy – high environmental impact projects may be good candidates
- Replacement power is readily available, although at higher cost
- Energy just one of many decommissioning factors and issues to evaluate and balance



## Staff Workplan Proposals for 2005

- Climate Change Effects on Hydro Generation
  - What are potential production changes in Sierra, Pacific Northwest and Colorado River Basin?
- Methods
  - Canvass utilities, producers and energy planning agencies for scenarios and projections
  - Review government, scientific and NGO literature
  - If data allow, attempt to correlate climate change scenarios with potential production changes
  - Qualitative review if insufficient quantitative data



# Hydropower Energy and Environment

- California Hydropower Impacts
  - No environmental baseline. No systematic footprint information
  - Begin developing metrics and datasets to measure environmental damage at level consistent with air quality work
    - Develop more specificity on scope of environmental damage reported in 2003 EPR / IEPR
  - Data request critical first step in quantifying system level effects
    - Length of bypass reaches, river miles inundated by reservoirs, reservoir sedimentation, basic hydrology, peaking production
- FERC Relicensing Effectiveness
  - Review recent cases to assess mitigation, potential for enhancement and restoration, operational changes and energy production changes



# Staff Hydro Workplan Proposal

- Small Hydro Energy Benefits and Environmental Costs
  - Begin assessing small hydro system:
    - 1,300 MW < 30 MW
  - Energy values and environmental impacts
    - Kilarc – Cow Creek Decommissioning Proposal – 4.6 MW
- Avoided Emissions from Hydro
  - Assess assumptions on quantities and benefits of avoided criteria pollutants and GHG emissions